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TWO NEW SPECIES OF NEOTROPICAL PARASITIC WASPS WITH HIGHLY MODIFIED OVIPOSITORS (HYMENOPTERA: BRACONIDAE: BRACONINAE AND DORYCTINAE)

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Abstract.—A new species of *Digonogastra* Viereck (Hymenoptera: Braconidae: Braconinae) from Argentina and a new species of *Heterospilus* Haliday (Hymenoptera: Braconidae: Doryctinae) from Venezuela and Brasil are described. Both new species have highly modified ovipositors with the apex formed into one or two arch-like regions. Ovipositor structure is interpreted functionally for both species.

Key Words: *Digonogastra, Heterospilus,* Braconidae, ovipositors, parasitic wasps, functional morphology

Digonogastra Viereck and *Heterospilus* Haliday are both large genera in the Neotropical Region, with over 500 species each, the majority of which are undescribed. Two new species, one in each genus, are described here because of their remarkable, apically arched or sickle-shaped ovipositors. These ovipositors are convergently similar to the arched ovipositors found in three Old World genera of Braconinae: *Zaglyptogastra* Ashmead (Quicke 1991), *Undabracon* Quicke, and *Cedilla* Quicke, as well as certain cremastine ichneumonids, e.g. *Pristomerus* Curtis (Quicke 1991). Nevertheless, there are also considerable differences among these ovipositors. For example, that of the new *Heterospilus* species is inverted in comparison with the otherwise similar ovipositor of *Cedilla* (Quicke and Tobias 1990), and that of the new *Digonogastra* species has a unique corrugated component and is mostly weakly sclerotized.

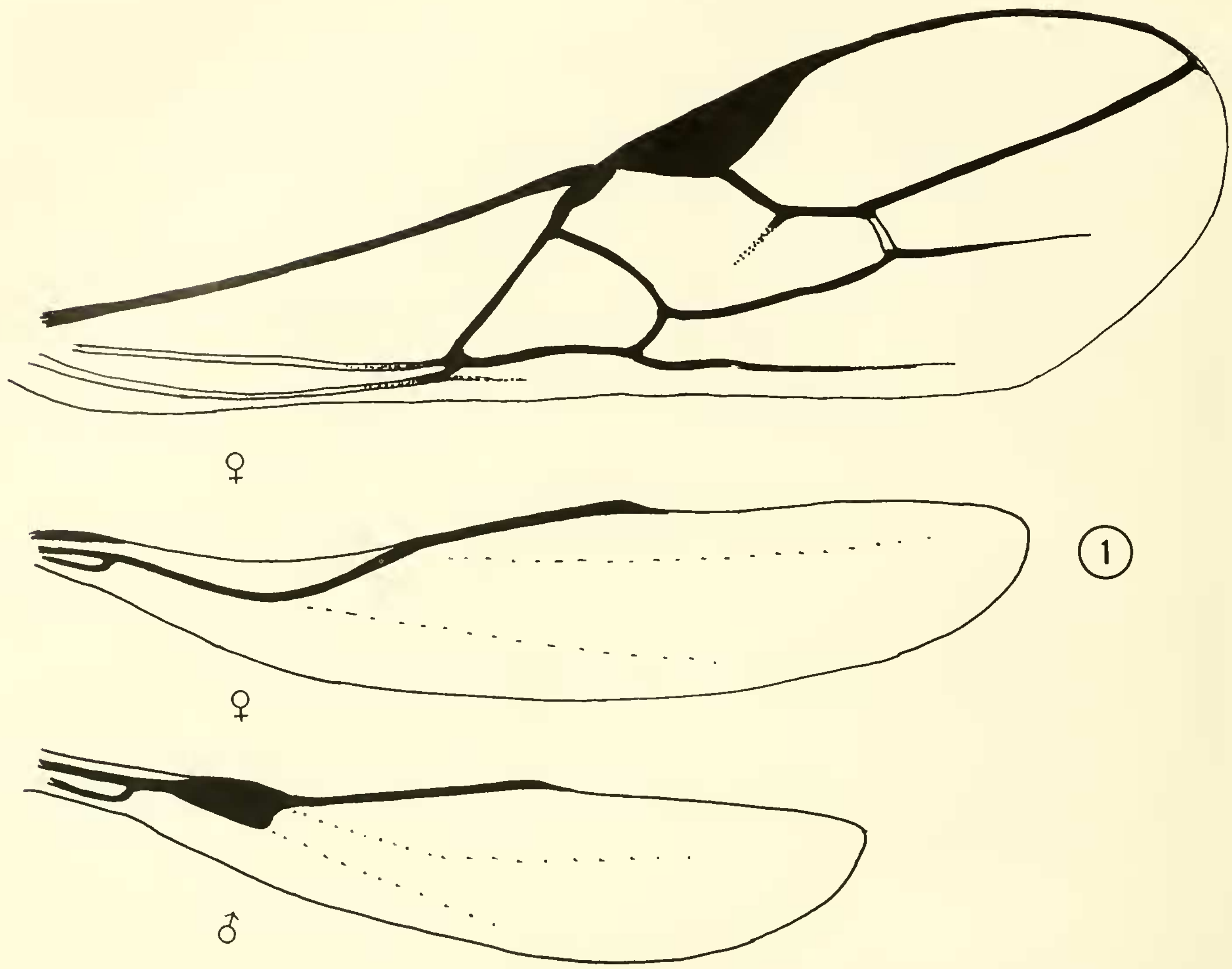
Authorship for each species is as indicated. Terminology for the descriptions follows that of van Achterberg (1979) and Quicke (1988). For consistency, van Achterberg's terminology is also employed here for the new species of *Heterospilus,* although previous works by the junior author on that genus have employed a different terminology (Marsh 1982a, b). A generic diagnosis for *Digonogastra* may be found in Quicke (1988) and for *Heterospilus* in Marsh (1965).

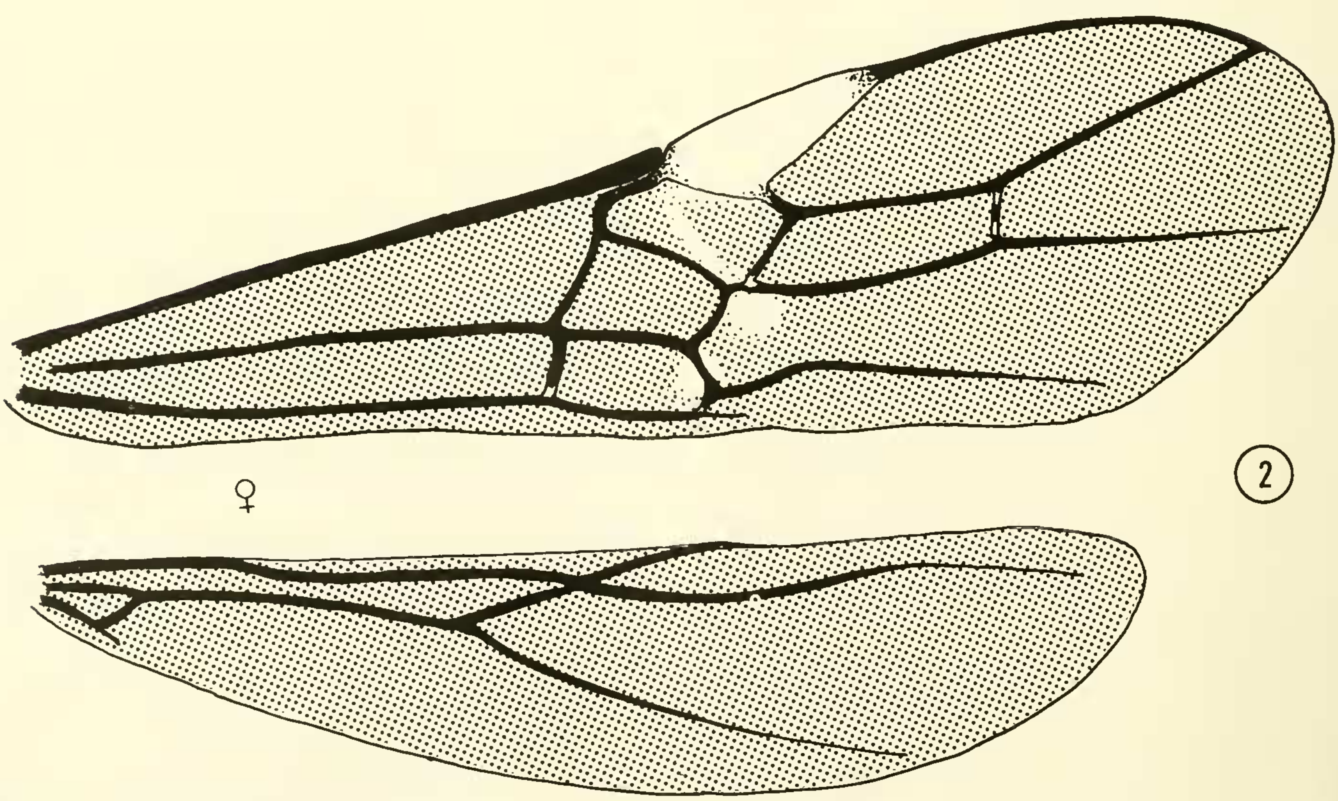
Depositories for specimens are listed by city as follows: Washington—National Museum of Natural History, Washington, D.C.; Ottawa—Biosystematics Research Centre, Ottawa, Canada; Sheffield—Department of Animal and Plant Sciences, University of Sheffield, Sheffield, England; London—The Natural History Museum, London, England.

Digonogastra zaglyptogastra Quicke, New Species

Figs. 2, 3–8, 20, 21

Female: Length of body, 6.0–8.5 mm; length of fore wing, 8.8–9.5 mm. Color. An-





Figs. 1, 2. Fore and hind wings. 1, *Heterospilus falcatus*, n. sp. 2, *Digonogastra zaglyptogastra*, n. sp.

tenna, head, propleuron, legs (except femora and sometimes hind tibia and tarsus), propodeum laterally and ovipositor sheaths black or piceous; remainder of body and legs "dirty" orange-brown; wings pale grey-brown, somewhat paler basally, with darker venation and largely pale yellow stigma.

Head (Figs. 3, 4): Antenna with 64 flagellomeres; terminal flagellomere acuminate, 2.5 times longer than maximally wide; penultimate flagellomere 1.7 times longer than wide; median flagellomeres 1.4 times longer than wide, first flagellomere 1.38 times and 1.5 times longer than the second and third flagellomeres respectively, the latter being 1.3 times longer than wide; scape elongate, longer ventrally than dorsally (Fig. 6); oral space (hypoclypeal depression) deep, dorsally rounded; transverse median clypeal carina poorly developed, not lamelliform; height of clypeus : inter-tentorial distance : tentorial-ocular distance = 1.0:2.9: 2.3; dorsal part of clypeus with rugulose sculpture; face with foveate-rugose sculpture, rather densely setose and with a distinct mid-longitudinal ridge medio-dorsally (Fig. 3); width of head : shortest distance between eyes : height of eye = 2.0:1.0:1.14; eyes with a few very short setae; frons moderately depressed with a well-developed mid-longitudinal sulcus, lateral half moderately setose; shortest distance between posterior ocelli : transverse diameter of posterior ocellus : shortest distance between posterior ocellus and eye = 1.3:1.0:2.9; length of head 2.6 times longer than horizontal length of eye.

Wings (Fig. 2): Forewing: lengths of veins SR1:3-SR:r = 8.0:5.1:1.0; lengths of veins 2-SR:3-SR:r-m = 1.8:3.9:1.0; vein cu-a interstitial to slightly postfurcal; vein 1-SR+M angled posteriorly shortly after arising from 1-SR. *Hindwing:* lengths of veins 1r-m: SC+R1 = 1.05:1.0; apex of vein C+SC+R with two or three thickened setae; base of wing evenly setose.

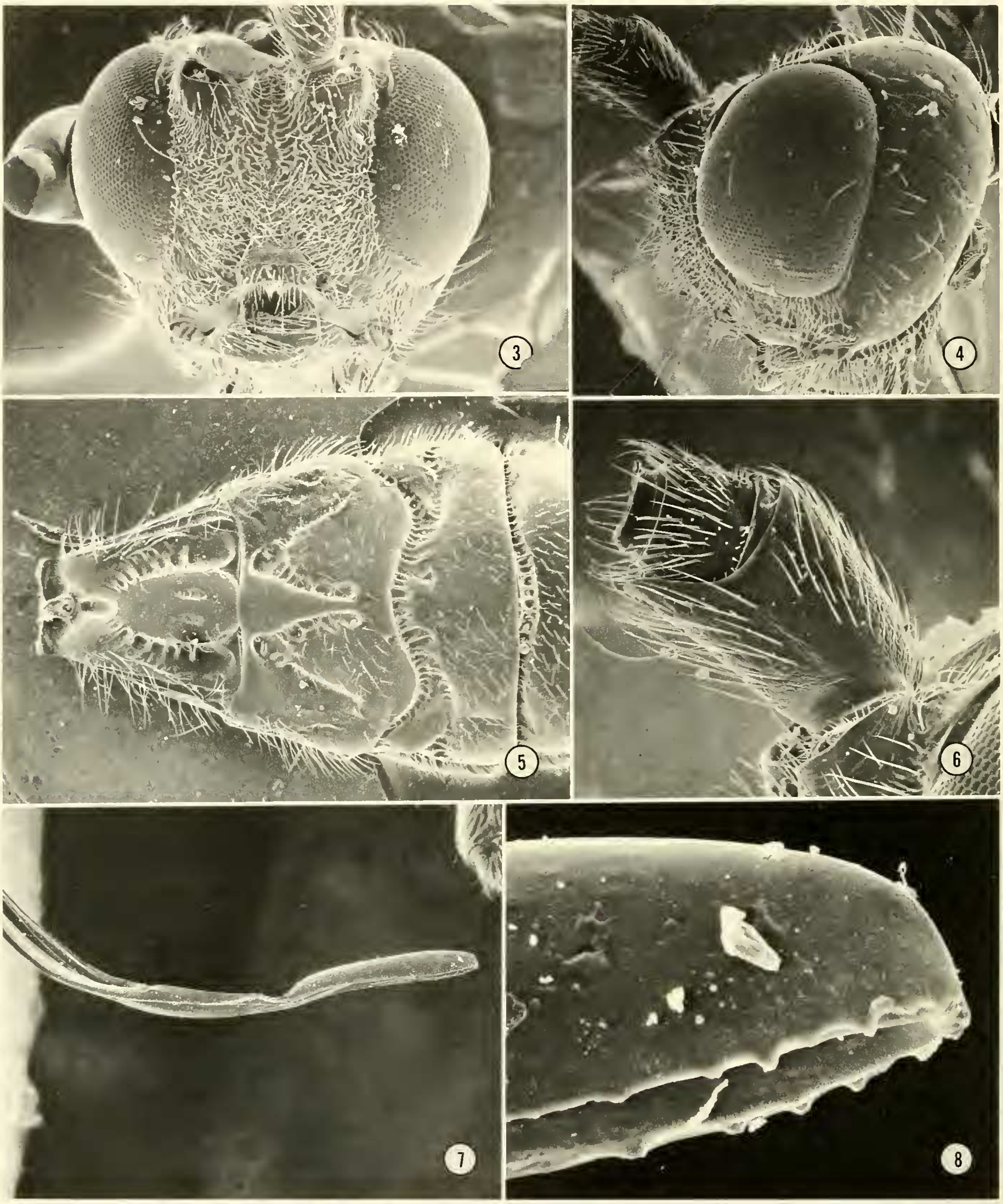
Legs: Lengths of fore femur : tibia : tarsus = 1.0:1.1:1.6; lengths of hind femur : tibia : basitarsus = 1.6:2.4:1.0; hindtibia slender with a well-developed longitudinal, lateral groove; hind basitarsus 6.85 times longer than deep.

Mesosoma: Smooth and shiny; 2.0 times longer than high; notauli absent except at extreme anterior margin of mesoscutum; scutellar sulcus narrow with approximately 12 transverse crenulae.

Metasoma (Figs. 5, 7, 8, 20, 21): Smooth and shiny, moderately setose; first tergum (Fig. 5) 1.22 times longer than wide, lateral carinae poorly developed, raised median area bordered laterally by crenulations, with pair of sub-medial pits shortly before posterior margin; second tergum (Fig. 5) 1.73 times wider than long medially, elongate mid-basal triangular area defined laterally by smooth or crenulate grooves, second suture sinuous and crenulate; third tergum (Fig. 5) with a more or less clearly defined, small mid-basal triangular area; terga 3–7 without transverse sub-posterior grooves; terga 4–6 with transverse peri-basal groove; ovipositor weakly sclerotized, markedly upcurved, approximately apical 0.25 formed into a pair of deep arch-like sections (Figs. 7, 20), both lower and upper valves similarly modified, sheaths with two pre-apical expanded sections (Fig. 21).

Type material.—*Holotype:* Female, ARGENTINA, Entre Rios Pronuciamento, October 1974. Deposited in Ottawa. Paratypes: 4 ♀, 2 ♂, same data as holotype; 5 ♀♀, topotypic but collected September 1964; 1 ♀, topotypic but collected December 1964. Deposited in Ottawa, Washington, and Sheffield.

Diagnosis.—This species is distinguished from all other known species of *Digonogastra* by the presence of two distinct, apical, arch-like regions of the ovipositor. The only other species of Braconinae with similar arched ovipositors belong to the exclusively Old World genera *Zaglyptogastra* and *Undabracon,* both of which have at least



Figs. 3–8. *Digonogastra zaglyptogastra*, n. sp. 3, face. 4, head, side view. 5, metasomal terga 1–3, dorsal view. 6, antennal scape, lateral view. 7, tip of ovipositor valves. 8, enlarged view of apex of dorsal valve of ovipositor.

three arch-like regions. Species of *Zaglyptogastra* seldom have a largely smooth metasoma (except for *Z. novaguinensis* Quicke and *Z. gaullei* Granger) and the two species which do lack the distinct mid-basal triangular area on the third metasomal tergum found in most *Digonogastra*, including *D. zaglyptogastra*. Species of *Undabracon*, as with other Aphrastobraconina, have the fore wing vein CU1b much wider anteriorly than vein 3CU1 posteriorly.

Heterospilus falcatus Marsh, New Species
Figs. 1, 9–19

Female: Length of body, 2.5–3.0 mm; length of fore wing, 1.5–1.75 mm. *Color:* Body brown; antenna with flagellum brown, pedicel brown or yellow, scape yellow; legs entirely yellow; wings hyaline, veins brown.

Head (Fig. 13): Antenna with 22–23 flagellomeres; length of malar space ⅓ eye height and about equal to basal width of mandible; temple narrow, about ½ eye width; oral space (hypoclypeal depression) wide and oval, width nearly twice length of malar space and equal to height of face (Fig. 13); ocelli small, ocellocular distance twice diameter of lateral ocellus; face granular; frons, vertex and temple finely granular, shining; malar space smooth, shining.

Mesosoma (Figs. 12, 14): Mesonotum and scutellum granular; notauli scrobiculate, meeting posteriorly in triangular rugose area; prescutellar furrow with 3–5 cross carinae; mesopleuron finely granular, nearly smooth dorsally, sternaulus deeply impressed and weakly scrobiculate, subalar groove rugose; propodeum rugose dorsally except for two large granular triangular areas at base bordered by strong carinae, granular laterally.

Wings (Fig. 1): Fore wing with first segment of radius (r) slightly longer than second segment (3-SR).

Legs: Hind femur swollen, about three times longer than wide.

Metasoma (Fig. 14): First tergum longitudinally striate, apical width twice basal width, length slightly longer than apical width; second tergum longitudinally striate on basal ¾; suture between second and third terga very weak or absent; remainder of terga smooth and shining; ovipositor (Fig. 9) nearly as long as body, usually curved upward, tip of valves expanded and sickle-shaped (Figs. 10, 15–18), tips of sheaths also expanded (Figs. 11, 19).

Male: Essentially as in female; hind wing with small stigma near base (Fig. 1), veins and stigma yellow.

Type material.—*Holotype:* Female, VENEZUELA, Edo. Aragua, Choroni, March 1952, P. Guagliumi, par. *Xyleborus confusus.* Deposited in Washington. Paratypes: 5 ♀, 4 ♂, VENEZUELA, same data as holotype; 1 ♀, 1 ♂, BRAZIL, Nova Teutonia, Fritz Plauman, 25-II-1937 and 9-X-1956. Deposited in London and Washington.

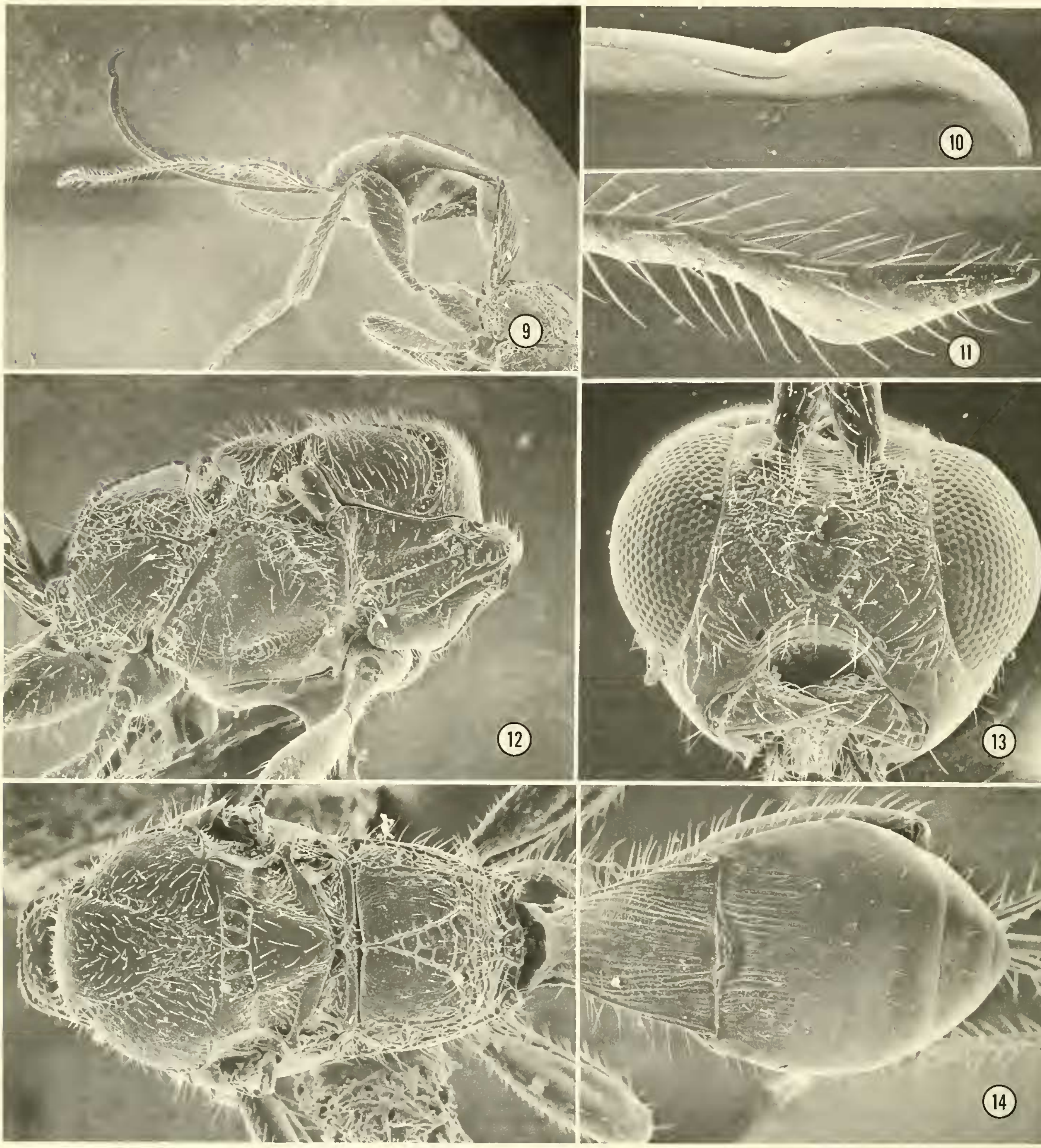
Etymology.—The specific name is from the Latin falcatus meaning sickle-shaped and refers to the unusual shape of the ovipositor.

Biology.—All of the type series from Venezuela were labeled as reared from *Xyleborus confusus* Eichhoff (Coleoptera: Scolytidae), which is a junior synonym of *X. ferrugineus* (F.).

Diagnosis.—This species can be distinguished from all other known species in the genus by the unusual shape of the tip of the ovipositor.

Discussion

Very little is known about the function of the singly or multiply arched ovipositors found in a number of braconid and ichneumonid genera. Host records are available for only one species of the Old World braconine genus *Zaglyptogastra* (Quicke 1983, 1991) and for some species of the ichneumonid genus *Pristomerus.* There are no published accounts of oviposition in either genus being observed in enough detail to explain the role(s) of their specialized ovipositors. Following his examination of museum specimens of *Zaglyptogastra,* which had died with their ovipositors in a variety of degrees of curvature, Quicke (1991) proposed that the arched form enables the wasp to manipulate the ovipositor apex in a vertical plane by sliding the lower valves posteriorly relative to the upper ones, resulting in a ventral curving of the apical part. The



Figs. 9–14. *Heterospilus falcatus*, n. sp. 9, lateral view of metasoma and ovipositor. 10, apex of ovipositor valves. 11, apex of ovipositor sheath. 12, mesosoma, lateral view. 13, face. 14, mesosoma and metasoma, dorsal view.

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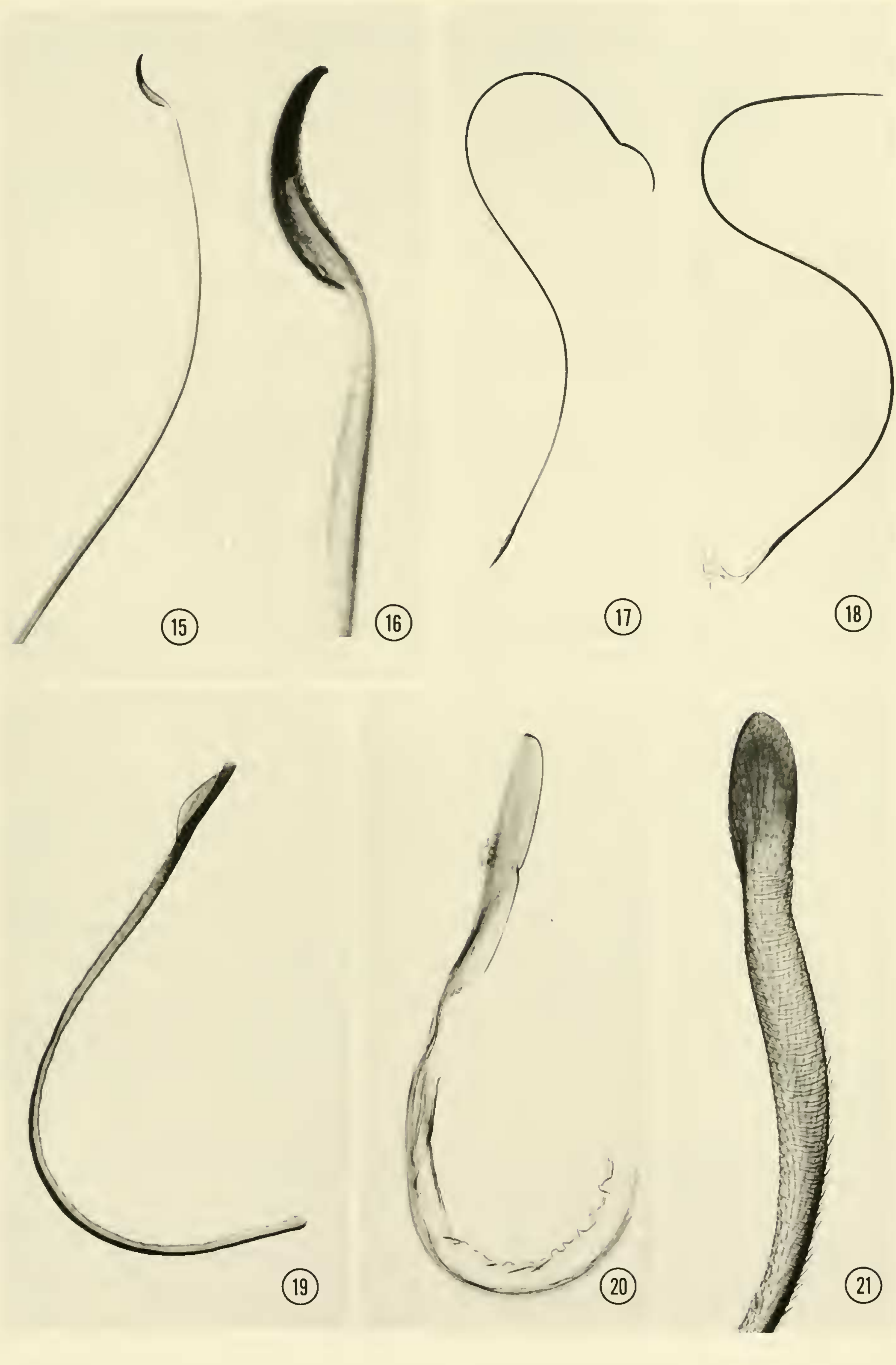
Figs. 15–21. Figs. 15–19, *Heterospilus falcatus*, n. sp. 15, dorsal ovipositor valve. 16, apex of dorsal ovipositor valve. 17, right ventral ovipositor valve, lateral view. 18, left ventral ovipositor valve, ventral view. 19, ovipositor sheath. Figs. 20–21, *Digonogastra zaglyptogastra*, n. sp. 20, dorsal ovipositor valve. 21, ovipositor sheath.



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only known host of *Zaglyptogastra* is the African coffee twig-boring cerambycid beetle, *Dirphya princeps* Jordan (Quicke 1983, 1991, El-Heneidy and Quicke 1991). Access to the *Dirphya* larva is almost certainly made via the row of frass holes the beetle makes at frequent intervals along the path of its excavation. The ability of *Zaglyptogastra* to manipulate its ovipositor through 180° probably greatly increases its ability to reach its host.

The multiply-arched ovipositor of *D. zaglyptogastra* probably functions in much the same way as that indicated above for *Zaglyptogastra* species. The biology of members of the genus *Digonogastra* is rather diverse and nothing is known of the hosts of the new species described here. Others, however, have been recorded from lamiine cerambycids (as for *Zaglyptogastra* above), Lepidoptera larvae in stems and seed pods (Quicke 1989, Wharton et al. 1989), and from bagworm moth larval cases (Psychidae). At least some of these hosts can be reached without the need to "drill" through a hard substrate. An ability to flex the ovipositor in some cases can easily be imagined as being useful. In approximately half of the known species of *Digonogastra*, the ovipositor has a pre-apical dorsal nodus and ventral serrations indicating a need to drill through a tough substrate. In the remainder of species, the ovipositor is robust and somewhat blade-like, lacking serrations; in these it seems likely that hosts are reached by pushing the ovipositor through a soft substrate. Thus, within *Digonogastra* there is considerable variation in ovipositor morphology, which is probably correlated with function.

The reasons underlying the similar but inverted ovipositor modification of *Cedilla* and *H. falcatus* are presumably based on a similar mechanical principle to that used by *Zaglyptogastra*. In the case of *H. falcatus*, protrusion of the ventral valves will result in an upwards rotation of the ovipositor apex which in turn may allow eggs or venom to be delivered to a part of the host that would not normally be reached by simple probing. Nevertheless, it is clear that in neither *H. falcatus* nor *D. zaglyptogastra* can the ovipositor be used to penetrate any hard substrate and, thus in both cases, access to the host is most probably via frass holes or similar easy routes.

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